

## ABSTRACT OF THE DISCLOSURE

An artificial retina device and a method for stimulating and modulating its function is disclosed. The artificial retina device is comprised of plural multi-phasic microphotodiode subunits. In persons suffering from blindness due to outer retinal layer damage, a plurality of such devices, when surgically implanted into the subretinal space, may allow useful formed artificial vision to develop. One device, called a MMRI-4, transduces light into electric currents to stimulate the retina. The four microphotodiode subunits of the MMRI-4 are oriented so that each flattened sides of the MMRI-4 has two subunits in a PiN configuration and two subunits in a NiP configuration. The flattened cubic shape of the MMRI-4 will allow one or the other of the two flattened sides to be preferentially directed toward incident light when implanted in the subretinal space. Because both the PiN and NiP configurations are present on each of the flattened sides of the MMRI-4, electric currents which produce the sensation of light from a PiN current, or darkness from a NiP current, can be induced regardless of which the flattened photoactive sides faces incident light. Filter layers disposed on the PiN configuration will allow visible light to induce a PiN current, and filter layers disposed on the NiP configuration will allow infrared light to induce a NiP current. By projecting real or computer controlled visible light images, and computer controlled infrared light images or illumination, simultaneously or in rapid alternation onto the MMRI-4s, the nature of induced retinal images may be modulated and improved. An Adaptive Imaging Retinal Stimulation System (AIRES), with a Projection and Tracking Optical System (PTOS), which may be worn as a headset is used for this purpose, and is also disclosed. Color images may even be induced by programming the stimulating pulse durations and frequencies of the AIRES system. By creating both PiN and NiP currents, in close spatial positions and temporal sequences, electrolysis damage to cellular tissue from prolonged unidirectional electric currents is reduced. MMRI-4s may also be embedded in a flexible, biologically compatible sheet, with its electrodes exposed on both surfaces of the sheet. This sheet is then implanted on the nerve fiber layer surface of the retina, where electrical stimulation can also induce a form of artificial vision.